Report on the East Central Saskatchewan Soil Conservation Project.

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INTRODUCTION

The East Central Saskatchewan Soil Conservation Project is a three year research and demonstration project designed to investigate:

1) the profitability of extended crop rotations
2) the value of reduced or conservation tillage

The key to this project is a three tiered field program consisting of:

1) three research sites which will examine grain and oilseed production under zero tillage, minimum tillage, and conventional tillage using continuous cropping and a 50/50 crop fallow rotation. All crop and soil paramenters are being monitored, and all inputs are being recorded so that a complete economic analysis can be made.

2) one demonstration site in each of the eight agricultural extension districts that form the region. These sites are planned in co-operation with the local agricultural representative and district extension board. Their purpose is to illustrate a practical field scale example of soil conservation that is of interest or concern to local producers.

3) Numerous field scale examples of conservation management practices already implemented by innovative farmers in the region.

Although soil and climatic conditions in this region are suitable for extended cropping, a large number of producers still employ a 50/50 crop - fallow rotation, leading to an excessive amount of unnecessary tillage. No soil conservation research has ever been conducted in this area and for this reason the project was established in this location.

This project involves three sponsoring groups:

1) Saskatchewan Agriculture:

Project demonstration sites are co-ordinated in consultation with the local agricultural extension districts. Extension activities such as tours, seminars, and field days are planned with the agricultural representatives.

2) Agriculture Canada:

Two research agronomists from the Indian Head Experimental Farm oversee the research component of the project. They assist with all field operations, data collection and analyses. Agriculture Canada has also provided the use of plot equipment and a considerable amount of shop time and labour for equipment preparation and maintenance.

3) Hoechst Canada Inc:

Hoechst has contributed technical assistance to develop and promote all levels of the field and extension programs. As well Hoechst has provided capital funding for the purchase of research equipment and supplies.

The majority of the funding for the project is provided through the Federal-Provincial Agricultural Development Agreement, ERDA. The remainder of the funding is provided by Hoechst Canada Inc., and four farmer members chosen from the various agriculture extension districts of East Central Saskatchewan.

SUMMARY OF RESULTS

RESEARCH PROJECT

The research portion of this soil conservation project has two main objectives. The first objective is to investigate soil conservation tillage practices to minimize the effects of soil erosion. The second objective is to investigate extended cropping to alleviate the process of soil degradation with the use of summerfallowing practices. The intent is to document in as much detail as possible, how tillage systems and cropping systems affect soil water, plant growth, weed populations and control, final grain yield and economic return. The 1986 growing season was used to set up the proper crop rotations and tillage systems. As well, some background measurements of soil fertility and weed spectrums were done on each plot at each of the three research sites.

The practice of summerfallowing results in the accumulation of nitrate nitrogen through the process of nitrogen mineralization, therefore, proper fertility and soil moisture management should alleviate the need for summerfallowing. Table 1 lists the amount of moisture present in the 0-120 cm soil profile under both fallow and stubble and gives the total amount of precipitation received from the beginning of May to the end of July. In Tadmore, summerfallowing only gave an additional 0.7 cm of water and because of the inherently low soil fertility, nitrogen, phosphorus, potassium and sulfur also had to be applied to the fallow plots. Consequently, the additional moisture saved with fallowing could have easily been saved with appropriate soil water conservation practices such as reduced tillage, snow trapping and/or direct stubble seeding. In the case of the Waldron and Ituna sites, fallowing resulted in saving approximately 4 cm of additional water. Again, this amount of

additional moisture could have easily been saved in a continuous cropping situation with proper soil water conservation practices. The fallow plots at Ituna and Waldron were fertilized to the same level as the stubble plots.

When the yields of Canola, Katepwa (hard red spring wheat) and HY320 (Canada Prairie spring wheat) are examined at all three sites (Table 2), the stubble yields were the same as the fallow yields. This means that in 1987, no yield differences due to fallowing were obtained. Consequently, when the economic analysis is done, the 50/50 rotation gave the worst economic returns.

With regards to tillage systems, the three tillage systems investigated (zero, minimum and conventional till) gave identical yields at all locations (Table 2). Absence of tillage did not result in significantly lower yields, therefore, reduced tillage practices can be adopted without having to experience reduction in yield. The best economic returns were with conventional and minimum tillage systems at all locations. Even with the current slump in commodity prices, adoption of soil conservation practices is economically feasible.

TABLE 1 Total water (cm) available for crop growth under three tillage systems and two cropping systems at three locations in East Central Saskatchewan

LOCATION	SOIL PROFILE (0-120 cm)		MAY TO JULY PRECIPITATION	TOTAL
Ituna	Stubble	26.0	21.3	47.3
	Fallow	30.3	21.3	51.6
Waldron	Stubble	21.7	16.2	37.9
	Fallow	25.7	16.2	41.9
Tadmore	Stubble	12.7	28.1	40.8
	Fallow	13.4	28.1	41.5

TABLE 2 The effects of three tillage systems and two cropping systems on the yield (kg/ha) of Katepwa, HY320 and Canola at three locations in East Central Saskatchewan

	LOCATION							
	TADMORE			WALDRON			ITUNA	
Cropping System	Katepwa	HY320	Katepwa	HY320	Canola	Katepwa	HY320	Canola
Tillage System - Zero								
Cont.	1198.0	1706.6	1440.9	2458.1	986.1	2390.3	3424.4	1286.9
50/50	1311.0	2000.4	1576.6	2085.2	1152.7	2593.8	3119.3	1186.7
Tillage System - Minimum								
Cont.	1469.2	1830.9	1118.9	1864.8	914.0	2407.3	3237.9	1116.0
50/50	1152.8	1864.8	1118.9	1763.1	871.6	3017.6	3729.6	1494.6
Tillage System - Conventional								
Cont.	1311.0	1740.5	1220.6	1847.8	1175.4	2797.2	3560.1	1398.6
50/50	1344.9	1740.5	1322.3	2051.3	1135.8	2729.4	3085.4	1486.1
MEAN	1297.8	1814.0	1299.7	2011.7	1039.3	2665.9	3359.5	1328.2

The use of Dr. Gordon Thomas' weed survey methodology greatly improved the amount of useful information generated from the 1987 weed survey. Weed density, weed frequency, field uniformity and relative abundance values are now generated for species comparison by site, tillage system, cropping sequence and crop. Further data analysis by density and relative abundance of weed types has allowed comparisons at a general level by each experimental factor. The weed population data of 1986 represents a background population and therefore tillage effects are limited (ie: zero tillage began in 1986). Another year's data is required to view trends over time caused by treatments. Data comparison however, is possible between 1986 and 1987.

In general, weed control measures were better employed in 1987 with greater vigilance being paid to fallow plots. Crops were seeded earlier to take advantage of spring moisture, however a spring drought severely decreased the competitive ability of the crops against weeds. At Tadmore, weed problems in canola due to this drought caused the loss of the canola crop.

TABLE 3: Tadmore Site Summary by Weed Type

WEED TYPE	DENSITY (#/M SQ)		RELATIVE ABUNDANCE (%)	
	86	87	86	87
ANNUAL GRASS WEEDS	704.3	359.6	44.3	41.8
ANNUAL BROAD-LEAVED WEEDS	94.6	97.7	46.4	47.4
WINTER ANNUAL WEEDS	1.1	0.2	4.9	3.9
PERENNIAL WEEDS	1.2	0.3	4.5	3.1
VOLUNTEER CROP WEEDS	0.0	9.0	0.0	4.0
	801.2	466.8		

Weed densities in 1987 were again the highest at Tadmore. Weed densities were reduced from the 1986 densities of 801.2 to 466.8 at Tadmore and from 46.2 to 30.3 at Ituna, while densities increased from 20.1 to 32.7 at Waldron . Decreased densities at Tadmore and Ituna were the result of improved weed control while the increase in density at Waldron was due to the less competitive 1987 crop.

Relative abundance values are based on weed frequency, uniformity and density and therefore is a relative comparison of abundance. The relative abundance of weed types was similar in 1986 and 1987 at Tadmore except with a slight increase in volunteer crops as weeds. This suggests that the weed population abundance of annual grass, broadleaved, winter annual and perennial weeds was the same in both years at Tadmore. At both Ituna and Waldron, the relative abundance of weed types changed in 1987. At Ituna, volunteer crops (primarily barley from pre-trial cropping) was reduced. Annual broadleaved weeds increased to the greatest extent while winter annual and perennial weeds increased to a lesser extent. At Waldron, the relative abundance of volunteer crops, annual grasses and annual broadleaved weeds increased while perennial weeds decreased.

TABLE 4: Waldron Site Summary by Weed Type

WEED TYPE	DENSITY (#/M SQ)		RELATIVE ABUNDANCE (%)	
	86	87	86	87
ANNUAL GRASS WEEDS	2.4	6.6	15.4	19.0
ANNUAL BROAD-LEAVED WEEDS	9.3	17.5	44.6	50.7
WINTER ANNUAL WEEDS	0.1	0.3	0.7	1.6
PERENNIAL WEEDS	8.0	6.7	38.0	22.6
VOLUNTEER CROP WEEDS	0.3	1.6	1.3	6.0
	20.1	32.7		

Comparing weed densities by tillage system at each site reveals that densities changed from 1986 and were different by system. At Tadmore, weed densities in zero, minimum and conventional systems were 705.2, 409.1 and 288 pl/m sq. respectively. This difference is primarily based on different green foxtail densities and to a much lesser extent, on broadleaved weed densities. At Waldron, zero, minimum and conventional tillage system weed densities were 31.2, 43.5 and 30.1 plants per meter square respectively. The greater density in the minimum tillage system is due primarily to an increased perennial weed density. At Ituna, zero, minimum and conventional system weed densities were 46.2, 25.0 and 20.4 respectively. The difference is primarily due to a greater annual broadleaved weed density in zero tillage.

Cropping sequence had an effect on the densities and relative abundances of weed types at each site. At Tadmore and Ituna, 1987 weed densities overall dropped significantly in continuous cropping while remaining the same in the crop/fallow sequence. Overall weed densities increased to a greater extent in continuous cropping than the crop/fallow sequence at Waldron. At Waldron, where background populations of perennial weeds was the highest, perennial weed density and relative abundance had increased in continuous cropping while it dropped the 50/50 rotation. This may be due to the aggressive use of Roundup on chemical fallow plots in 1986. This would explain the overall drop in relative abundance of perennial weeds at this site.

At all sites annual grass weeds (primarily green foxtail) increased significantly in density and relative abundance in the crop/fallow sequence while either increasing only slightly (Waldron) or decreasing in the continuous cropping sequence. The spring of 1987 was ideal from a heat and open crop canopy perspective for green foxtail growth and development. In some plots (except Tadmore) the densities of green foxtail would be considered below the economic threshold levels.

TABLE:5: Ituna Site Summary by Weed Type

WEED TYPE	DENSITY (#/M SQ)		RELATIVE ABUNDANCE (%)	
	86	87	86	87
ANNUAL GRASS WEEDS	10.0	3.6	18.0	17.9
ANNUAL BROAD-LEAVED WEEDS	13.8	18.5	42.6	54.4
WINTER ANNUAL WEEDS	0.2	0.8	0.9	2.7
PERENNIAL WEEDS	1.8	2.2	8.4	10.0
VOLUNTEER CROP WEEDS	20.4	5.2	30.1	14.3
	46.2	30.3		

At Waldron and Ituna the canola crop had higher weed densities than HY320 or Katepwa spring wheat by about a factor of 2 (Canola crop failure at Tadmore). At Waldron and Ituna, weed densities were higher in HY320 than Katepwa, while in Tadmore they were considerably lower (note that 1986 densities between wheats was similar at all sites). Another year is required before crop by weed population generalizations can properly be made.

DEMONSTRATION PROJECT

One demonstration project has been established for each of the eight agricultural extension districts making up the East Central Extension Region. Each project is a field scale site planned in co-operation with the local agricultural representative and district extension board. This ensures that the project will address some practical soil conservation issues particular to each district, and of interest or concern to the producers in that district.

The yield data from the 1987 demonstration projects represents the average yield from several test strips harvested within each plot. Although trends may appear in the data when the results are compared to data from 1986, there is no statistical significance to the variation. The remarks and observations made are not conclusive and are included for discussion puposes only.

Agronomy information for each demonstration site has not been included in the Executive Summary. This information is provided in Section B of the complete report. Seeding dates, seeding rates, and fertilizer treatments at each site were similar to the methods predominant in that area. Where more than one seeding implement was used, the date of seeding, seeding rate, seeding depth and fertilization rate was kept constant to eliminate confounding effects.

Extension District #12 - Yorkton

Straw management has become a problem for producers who continuous crop or use extended cropping rotations. This site studies straw management under those conditions. Treatments include comparisons of seedbed preparation and seeding methods (airseeder vs double disc press drill), different tillage treatments (cultivator vs tandem disc, spring vs fall tillage) and different straw management techniques.

Results:

Double disc press drill	-fall tandem disced	- 35.5 bu wht/ac
	-not disced	- 34.0
Airseeder	-fall tandem disced	- 31.7
	-not disced	- 32.0

Both press drill treatments produced higher average yields than the airseeder treatments. Poor moisture conditions at seeding, combined with superior packing capability of the press drill may be responsible for this yield variation. Tandem discing was not an economical practice, despite the small yield advantage attained in the press drill treatment.

Extension District #13 - Melville

There is concern amongst producers about the timing of tillage treatments as they pertain to seedbed preparation and trash retention for erosion protection. This project studies various types and amounts of fall and spring tillage to determine which management system best meets the producer's needs.

Results:

Plot #	Fall Operations	/ Spring Operations	Yield
1	1 tillage, banded	/1 tillage, seeded - fallow	40.7
2	1 tillage, banded	/1 tillage, seeded - stubble	30.9
3	1 tillage, banded	/seeding	32.4
4	1 tillage	/banded, seeding	31.2
5	2 tillage	/banded, seeding	33.8
6	Banded	/1 tillage, seeding	33.2
7	Banded	/seeding	32.9
8	No fall work	/banded, seeding	35.7
9	No fall work	/1 tillage, banding, seeding	35.2
10	Chemfallow	/banding, seeding	34.4

The highest yield was obtained on plot #1 which was summerfallow in 1986. Plots receiving no fall tillage or banding (plots #8,9,10) produced higher yields than those plots that were cultivated and/or banded in the fall.

Extension District #18 - Kamsack

In 1987, this site studied minimum tillage seeding where seeding and fertilizing were combined into one operation with an airseeder, in comparison with the conventional method of preplant

nitrogen banding, followed by seeding and seed placing the additional fertilizer requirements.

Results:

Minimum tillage - seed placed fertilizer	65.0 bu/ac barley
Conventional tillage - banded fertilizer	85.0
Unfertilized strip in conventional treatment	22.5

The plot where nitrogen was banded produced the highest yield, even with the additional tillage operation. Some of the yield advantage of the banded plot over the seed placed plot may be attributable to seedling damage due to the high rate of seed placed nitrogen.

Extension District #19 - Canora

Conventional seedbed preparation in this area includes fall and spring tillage to reduce surface residues and to dry the soil surface. Seeding is normally done with a double disc press drill. The project compares the conventional tillage/seeding system with a system that uses either an airseeder or a hoe press drill to reduce tillage and maintain surface residues.

Results:

Airseeder	55.8 bu/ac barley
Hoe press drill	55.9
Double disc press drill	52.4

The airseeder and hoe press drill produced 3-5 bushels/acre more than the double disc press drill.

Extension District #20 - Wynyard

Three different seeding systems are being compared in a minimum tillage extended crop rotation. This site has been continously cropped for eight years. The only non-seeding tillage operation is a fall fertilizer banding treatment. Variations in crop emergence, weed density, trash clearance and penetration, and crop yield are being monitored.

An adjacent Maximum Economic Yield (MEY) plot studies minimum tillage fertilization; comparing a nitrogen only treatment to a nitrogen and phosphorus treatment. The objective is to determine the most efficient method of investing $15/acre in fertilizer.

Results:

Airseeder	40.9 bu/acre wheat
Hoe press drill	39.3
Discers	38.6
MEY - N only	31.2
MEY - N and P	34.0

The yield differences at this site may be attributed to variations in the ability of the various implements to control weeds at the time of seeding and their packing ability. In the MEY treatments, sidebanding both nitrogen and phosphorus at seeding produced a higher yield than the plot where only nitrogen was sidebanded.

Extension District #39 - Fort Qu'Appelle

This site studies the agronomic and economic feasibility of three cropping rotations:

a) continuous cropping
b) 50/50 crop-fallow rotation
c) 2/3:1/3 rotation

A fall tillage treatment was superimposed over half of each rotation treatment and the stubble was left standing to trap snow on the other half. The effect of these two treatments will be monitored through 1987 and 1988.

Results:

Continuous cropped	- fall tandem disced -	17.2 bu/ac wheat
	- not disced	19.3
2/3:1/3 on stubble	- fall tandem disced -	13.4
	- not disced	15.7
2/3:1/3 on fallow		40.6
1/2:1/2 on fallow		40.0

The highest yields were obtained on plots seeded on summerfallow. Fall tandem discing produced lower yields than treatments where straw residue was retained for snow trapping. Inadequate snow cover may have influenced the yield variation between disced and undisced treatments.

Extension District #42 - Kelvington

Conventional management practices in this district involve a combination of fall and spring tillage and seeding with a double disc press drill. This project compares the conventional management system to a minimum tillage system using an airseeder and a seedrite. In 1987, a minimum tillage, seed placed fertilizer treatment was included.

Results:

Airseeder	41.8 bu/acre barley
Double disc press drill	45.4
Seedrite	44.4
Minimum tillage (seedplaced fertilizer)	55.9

Seedplacing 26-13-0 (with an airseeder) with no prior spring tillage, outyielded the treatments where nitrogen was preplant banded. The yield variation may be attributed to moisture retained by not cultivating the soil to apply nitrogen

fertilizer. Amongst the spring banded treatments, the double disc press drill produced the highest yield.

Extension District #43 - Watrous

The economic and agronomic feasibility of the two crop rotations common in this district will be compared: continuous cropping vs 2/3:1/3 rotation.

Results:

Continuous cropping	26.6 bu/ac wheat
2/3:1/3 on fallow	32.5
2/3:1/3 on stubble	28.1

The highest yield was obtained on summerfallow. This may be attributable to moisture retained during the fallow year. Poor spring mositure reserves at seeding time may also have influenced results.

Complete report available from David Struthers ,Conservation Agronomist, East Central Saskatchewan Soil Conservation Project, A.G. Kuziak Building, 72 Smith Street East, Yorkton, Sask. S3N 2Y4